

National Numeracy Tests

REASONING

9ER16MS

Marking the test
and understanding performance



139162



Llywodraeth Cymru
Welsh Government

Marking the reasoning test

This document comprises:

- the markscheme for the National Numeracy Test (Reasoning) for Year 9 together with marking guidance
- additional information to support teachers' understanding of their learners' responses, providing a platform for growth.

For learners using the modified large print or Braille test materials, some questions have been adapted or replaced. When marking a modified large print or Braille test, please use this markscheme alongside the adapted markscheme which is included in the *Notes for teachers* that accompany the modified tests.

All items within this test require numerical reasoning and therefore most are open, allowing the learner to select what they consider to be an appropriate strategy. This means that there may be a range of ways of arriving at a solution.

As a consequence, marking the reasoning tests may not be as straightforward as simply checking whether or not the final answer is correct since the methods used are also of importance.

Understanding the markscheme

To ensure the accessibility of the markscheme, the focus is primarily on key pointers that indicate the learner's understanding. For example, the markscheme may state 'Shows the value **12**' or 'Links **36** to **9**'.

These values generally credit intermediate stages, showing partial understanding.

Alongside this, commentary is provided as appropriate, to enable markers and teachers to understand their learners' responses and also to support marking.

Common errors are also flagged up, as well as explanations as to why certain responses are awarded partial credit.

Exemplars

To help schools not only with marking but also in interpreting their learners' responses, a range of exemplars is provided for each item, as appropriate.

These exemplars are actual responses from learners (taken from a trial of the reasoning tests) so include spelling mistakes and numerical inaccuracies. They have been typed to ensure anonymity.

Assessing and building on test performance

Marking the test gives teachers an overall score for each learner.

However, this score in isolation is unlikely to provide a great deal of information relating to the strengths of individual learners, or evidence of those areas of numerical understanding and reasoning skills that require improvement.

Equally, comparing learners' scores may mask significant differences in their performance. For example, two learners may both score 12. However, within that overall score Learner A may show a clear ability to communicate effectively but need support to review their work, while Learner B may show the exact opposite.

For this reason, the markscheme and the accompanying materials are designed to provide teachers with a deeper assessment of both individual and class performance.

Diagnostic tool

To assist in interpreting and building on test performance, a diagnostic tool is provided.

This can be accessed via gov.wales/learning

At its simplest level, the diagnostic tool provides markers with a check on the total score for that particular learner.

However, completing the full set of data on each learner gives the teacher an overview of class performance, identifying group or individual strengths and problem areas and hence indicating further teaching needs.

Building on the test: classroom activities

Having assessed learners' ability to apply numerical reasoning and identified areas for both individual and class development, teachers may then wish to build on the test experience and materials through accessing gov.wales/learning

This site provides the test items and associated markschemes, but also includes additional materials with suggestions for linked classroom activities to extend the learning.

In addition, further activities supporting the learning and teaching of numerical reasoning can be found on gov.wales/learning

Markscheme

General marking rules

It is essential that you apply this markscheme, the marking guidance and the general marking rules given below to your own marking, in order for the standardised scores to be valid.

- The marking guidance shown within the markscheme should be applied to find the relevant score for each question. No half marks are awarded.
- At the end of each double-page spread of marking, record the total number of marks in the 'total' box in the bottom right-hand corner. Check that the mark recorded does not exceed the maximum number of marks available.
- Once the marking has been completed, add up the total number of marks awarded. This is the total score and should be recorded on the cover of the test booklet and input onto the relevant mark sheet on the school's management information system, together with the details and date of the test taken.
- Markers should record their initials on the cover of the test booklet to assist quality assurance.

This data should then be submitted as part of the Welsh National Tests Data Collection (WNTDC). Further details are available from the *National Reading and Numeracy Tests – Test administration handbook 2016* on the Learning Wales website and in *Welsh National Tests Data Collection and reporting arrangements 2015/16* available on the Welsh Government website.

Marking guidance

It is important that the tests are marked accurately. The questions and answers below help to develop a common understanding of how to mark fairly and consistently.

Must learners use the answer boxes?

Provided there is no ambiguity, learners can respond anywhere on the page. If there is more than one answer, the one in the answer box must be marked, even if incorrect. However, if the incorrect answer is clearly because of a transcription error (e.g. 65 has been copied as 56), mark the answer shown in the working.

Does it matter if the learner writes the answer differently from that shown in the markscheme?

Numerically equivalent answers (e.g. eight for 8, or two-quarters or 0.5 for half) should be marked as correct unless the markscheme states otherwise.

How should I mark answers involving money?

Money can be shown in pounds or pence, but a missing zero, e.g. £4.7, should be marked as incorrect unless the markscheme states otherwise.

How should I mark answers involving time?

In the real world, specific times are shown in a multiplicity of ways so accept, for example, 02:30, 2.30, half past 2, etc. Do not accept 2.3 as this is ambiguous. The same principle should be used for marking time intervals, e.g. for two and a half hours accept 2.5 but not 2.5pm.

What if the method is wrong but the answer is correct?

Unless the markscheme states otherwise, correct responses should be marked as correct even if the working is incorrect as learners may have started again without showing their revised approach.

What if the learner has shown understanding but has misread information in the question?

It is important that learners select the appropriate information and review their work. However, for most questions, method marks can still be obtained.

What should I do about crossed-out work?

Working which has been crossed out and not replaced can be marked if it is still legible.

What is the difference between a numerical error and a conceptual error?

A numerical error is one in which a slip is made, e.g. within 86×67 the learner works out $6 \times 7 = 54$ within an otherwise correct response. A conceptual error is a more serious misunderstanding for which no method marks are available, e.g. if 86×60 is recorded as 516 rather than 5160

What if learners use a method that is not shown within the markscheme?

The markscheme shows the most common methods. However, there can be a wide range of approaches to a question and any correct method, however idiosyncratic, is acceptable.

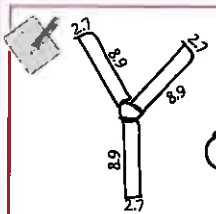
In all questions, the correct answer should be given full marks, whatever the method used, unless the markscheme states otherwise.

Most questions give partial credit for responses that show a correct method but the answer is incorrect or incomplete: a correct method is one that would lead to a correct answer if there were no numerical errors.

9ER16 Reasoning test: Markscheme

Q	Marks	Answer	
1i	3m	Shows 446 to 447 inclusive, e.g. <ul style="list-style-type: none"> • 446.958 <p>Or</p> <p>Otherwise justifies 450, e.g.</p> <ul style="list-style-type: none"> • $2.7 \times 8.9 = 24.03$, $24.03 \times 6.2 = 148.986$ which is almost 150, then $\times 3 = 450$ • $2.7 \times 8.9 \times 6.2 \times 3$ is about 450 	<p>Outcome from the most common method. For 3m do not accept 446.0 or 447.0</p> <p>Accept working backwards from 450 to justify panels/watts/area needed, e.g.</p> <ul style="list-style-type: none"> • $450 \div (2.7 \times 8.9 \times 6.2) = 3.02$ panels • $450 \div (2.7 \times 8.9 \times 3) = 6.24$ watts • $450 \div 6.2 = 72.6\text{m}^2$ and $3 \times 2.7 \times 8.9 = 72.1\text{m}^2$
	Or 2m	Shows any of the following: <ul style="list-style-type: none"> 148 to 149 inclusive 72.09 (accept 72 or 72.1) 18.7(...) <p>Or</p> <p>Shows or implies a correct method even if there are rounding or numerical errors</p>	<p>148 to 149: Power, one panel</p> <p>72.09: Area in m^2 of three panels</p> <p>18.7(...): 450 + area of one panel</p> <p>Accept 446.0 or 447.0</p>
	Or 1m	Shows 24.03 (accept 24 or 24.0) <p>Or</p> <p>Shows any of the following:</p> <ul style="list-style-type: none"> $2.7 \times 8.9 \times 6.2$ $2.7 \times 8.9 \times 3$ $450 \div (2.7 \times 8.9)$ 	<p>Area in m^2 of one panel</p> <p>Accept $450 \div 2.7 \div 8.9$ but not $450 \div 2.7 \times 8.9$</p>

Question 1i: Exemplars




① Area of 1 solar panel = 2.7×8.9
= 24.03

② There are 3 solar panels in total, so multiply 24.03 by 3.
 $24.03 \times 3 = 72.09$

③ 1 square metre = 6.2 watts
 $72.09 \times 6.2 = 446.958$

Correct; 3 marks

- This learner's work is clearly explained showing good numerical communication.



$2.7 \times 8.9 = 24.03$


$24.03 \times 6.2 = 148.986$

$450 \div 148.986$
= 3.02 panels

Therefore 3 panels will give off about 450 watts of power.

Correct; 3 marks

- Most learners work 'forwards' to find the number of watts, but this method is also correct.



$2.7 \times 8.9 = 24m^2$


$24 \times 6.2 = 149m$

$149 \times 3 = 447.0$

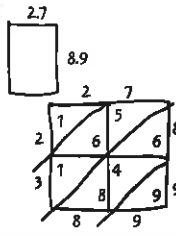
Correct method; 2 marks



This learner rounds at each stage. Although 447 scores 3 marks, 447.0 implies that the answer is more accurate than it really is, which is why it is not accepted for 3 marks.



$2.7 \times 8.9 = 23.89m^2 \times 6.2 = 148.118$


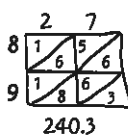


$148.118 \times 3 = 444.354$

round up \downarrow
450 watts

Correct method; 2 marks

- By not using a calculator, this learner calculates inaccurately so loses a mark. It is time-consuming to work out calculations in this way, time that would be better spent on other questions, or in checking.

240.3

$\begin{array}{r} 240.3 \\ \times 3 \\ \hline 720.9 \end{array}$

$2.7 \times 8.9 \times 3$; 1 mark

- Although the decimal points are not shown within 2.7 and 8.9, the learner is clearly multiplying together these values, and then multiplying their answer by 3

Q	Marks	Answer
1ii	3m	7.9 metres, or 7.90569(...) rounded or truncated to at least 1 d.p.
	Or 2m	Shows any of the following: 7.9(...) 62.5 10.6(...) 15.8(...) Or Shows a method that would lead to 7.9(...) if calculated correctly, e.g. <ul style="list-style-type: none"> • $450 \div 1.8 \div 4$, then finds the square root of that answer
	Or 1m	Shows either of the following: 250 112.5 Or Shows the intention to find a square root Or Answer 8m without a method that would lead to 7.9(...)

Accept 8 provided a more accurate value, or a correct method with no rounding errors, is also shown

62.5: Area, in m², of each panel

10.6: $\sqrt{112.5}$ (+ 1.8 omitted)

15.8: $\sqrt{250}$ (+ 4 omitted)

250: Number of m² required

112.5: Watts per panel

Question 1ii: Exemplars



$$7.9 \text{ m}^2 \times 7.9 \times 1.8 = 112 \text{ watts} \times 4 \\ = 450 \\ \text{(rounded 2 DP)}$$

each solar panel should be 7.9m^2
~~side~~ which will give 450 watts once
it reaches saturn

$$7.9 \text{ m}^2$$

Correct; 3 marks

- Although this learner shows incorrect units (7.9m^2 rather than 7.9m), the value 7.9 is enough to gain all 3 marks, despite the statement 'rounded 2 DP' when they mean rounded to 2 s.f.



$$450 \div 4 = 112.5$$

$$112.5\text{m} \div 1.8 = 62.5 \text{ m}$$

$$8 \times 8 = 64$$

$$8 \text{ m}$$

Shows 62.5; 2 marks

- Had $\sqrt{62.5}$ been shown, this learner would have gained 3 marks for the answer 8m as this would show a complete correct method.



$$450 \text{ watts} \div 4 \text{ panels} = 112.5$$

$$112.5 \text{ watts (per panel)} \div 1.8 \text{ watts (per metre)} \\ = 62.5 \text{ metres (per panel)}$$

$$4 \text{ sides on the panels: } 62.5 \div 4 \\ = 15.625\text{m for each side}$$

$$15.625 \text{ m}$$

Shows 62.5; 2 marks



This learner also uses some incorrect units, but otherwise communicates well. Dividing 62.5 by 4 (confusing area and perimeter) is a very common error.



$$1 \text{ solar panel} = 8 \times 8 \\ = 64\text{m}^2$$

$$64 \times 1.8 = 115$$

$$115 \times 4 = 460$$

$$4 \text{ solar panels} = 460 \text{ watts}$$

$$8 \text{ m}$$

Answer 8m; 1 mark

- This learner shows a method for checking whether 8 is an approximately correct side length, but no method for finding 7.9(...), so only 1 mark can be awarded.

Q	Marks	Answer
2	3m	0.1 kilometres per hour, with no evidence of an incorrect method
	Or 2m	Shows 0.4 or 400
	Or 1m	Shows 0.6 or 600 Or Gives an incorrect distance for robot A, but then follows through correctly to find the speed of robot B, i.e. (1 – their distance in km for A), then $\div 4$, or (1000 – their distance in m for A), then $\div 4$

Distance moved by robot B, in km or m

Distance moved by robot A, in km or m

Their distance must be greater than 0km and less than 1km

Note: A correct and efficient method, though unlikely to be seen, is to reason that as the total of 1km must be covered in 4 hours, the combined speed of the two robots must be 0.25km/h. As robot A moves at 0.15km/h, robot B must move at $0.25 - 0.15 = 0.1\text{km/h}$. This scores 3 marks, and $0.25 - 0.15$ scores 2 marks.

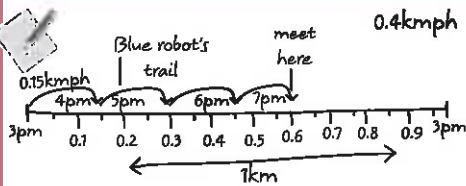
Question 2: Exemplars



$\frac{1}{10}$ kilometres per hour

Correct; **3 marks**

- $\frac{1}{10}$ is equivalent to 0.1, and there is no evidence of incorrect working, so all 3 marks can be given. However, this learner should be encouraged to show their working since justifying conclusions is an essential part of becoming numerate.

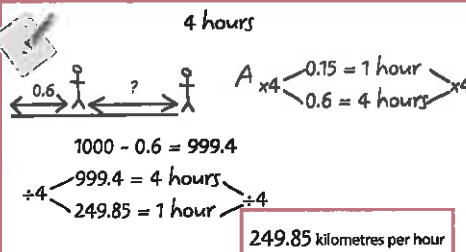


0.4 kilometres per hour

Shows 0.4; **2 marks**



This learner uses a number line to support their thinking but forgets that robot B moves for four hours, not one.



249.85 kilometres per hour

Shows 0.6; **1 mark**

- This learner confuses units. A speed of almost 250km/h when the distance apart is 1km makes no sense, and should have alerted them to their error.



A moves at 0.15 km/h
in 4 hours it will be 0.75 km through
the track
robot B needs to travel 0.25 in
4 hours = $0.25 \div 4$

0.06 kilometres per hour

Correct follow-through; **1 mark**

- 0.75 is incorrect (it should be 0.6) but from then on the method is correct. Rounding or truncation to 1 or more significant figures is condoned.



$$0.15 \times 6 = 0.9$$

The orange robot must travel
0.1 km/ph to reach the 1km
at 7pm

0.1 kilometres per hour

Incorrect; **0 marks**

- The method is incorrect, and no correct values are shown, so no marks can be given even though the answer is 0.1km/h.

Q	Marks	Answer
3	2m	<p>Justifies why it is not equal to £50, e.g.</p> <ul style="list-style-type: none"> • 10% of £50 = £5, so the new price is £45 10% of £45 = £4.50 so 50p short • It is reduced by £5 but increased by only £4.50 <p>Or</p> <p>States that the increase should be 11.(...)%</p>
	Or 1m	<p>Shows 45</p> <p>Or</p> <p>Shows 4.5(0)</p> <p>Or</p> <p>Makes an error when calculating the 10% decrease, but then calculates the 10% increase correctly</p>

Accept **49.5(0)** as sufficient evidence that it is not £50

Also accept **4.5(0)** as sufficient evidence that it is not £5

Question 3: Exemplars



$$50 \times 0.9 = \pounds 45$$
$$45 \times 1.1 = \pounds 49.50$$

Correct; **2 marks**

- This learner shows good numerical understanding, using knowledge of decimals to work efficiently.



$\pounds 50$ reduced by 10% = $\pounds 5$ = $\pounds 45$
When $\pounds 50$ is reduced by 10% it ends up as $\pounds 45$. So $\pounds 45$ increased by 10% = $\pounds 4.50$ = $\pounds 49.50$
This is $\pounds 49.50$. So no when you decrease $\pounds 50$ by 10% and then increase by 10% it is equal to $\pounds 49.50$ which is not the same as $\pounds 50$ as it is 50p less.

Correct; **2 marks**

- This learner would benefit from discussion as to why repeated use of the equals sign is incorrect, and why the final sentence adds nothing to the work already done.



$$\pounds 50 = 10\% = \pounds 5$$
$$10\% = \pounds 4.50$$

Correct; **2 marks**

- This learner shows poor numerical communication. However, showing $\pounds 5$ with $\pounds 4.50$ is sufficient to gain 2 marks.



It is reduced by 10% = $\pounds 10$
so new price = $\pounds 40$
10% of 40 = $\pounds 4$ so now it is $\pounds 44$ not $\pounds 50$ so no they are not equal.

Calculates 10% increase correctly; **1 mark**

- Although there is an error in the first step of the calculation, the second step, leading to $\pounds 44$, is calculated correctly.



$$\pounds 50 - 5 = \pounds 45$$
$$\pounds 45 + 5 = \pounds 50$$

Yes its equal

Shows 45; **1 mark**



This learner has assumed that as the decrease of 10% is $\pounds 5$, the increase of 10% must also be $\pounds 5$. This is a common error.



Yes it is the same because it is reduced by 10% and then it is increased by 10% and $10\% = 10\%$

Incorrect; **0 marks**



It is also common for learners to assume that the percentage increase must be the same as the percentage decrease, without checking.

Q	Marks	Answer
4	2m	12cm
	Or 1m	<p>Shows 72 ÷ 6, or links 72 to 6 sides of the squares</p> <p>Or</p> <p>Shows 36 ÷ 3, or links 36 to 3 sides of the square</p>

Question 4: Exemplars

the long one must be double the sides
need to be the same

12 24 12 12 12 12

12 cm

Correct; 2 marks

- This learner uses proportional reasoning to reach a correct solution.

$A = \frac{1}{2} B$

sides B and C make $\frac{2}{3}$ of the perimeter
sides A and D make $\frac{1}{3}$ of the perimeter

$72 + 3 = 24$
 $24 + 2 = 12$
side A = 12
side D = 12

$\frac{1}{2}$ side B = 12
 $\frac{1}{2}$ side C = 12

12 cm

Correct; 2 marks

- This approach is also correct.

36 cm = 3 sides
each side = 12cm
Square has 4 sides so 48cm.
 $48 \times 2 = 96$

96 cm

Links 36cm to 3 sides; 1 mark

- Although this learner has found the correct side length, by continuing to work out the total perimeter of both squares they have not given the correct answer. As such, only 1 mark can be given.

rectangle = 72cm
Square = 36 half of that

each square $9 + 9 + 9 + 9 =$

9 cm

Incorrect; 0 marks

Common error It is common for learners to assume that the perimeter of each square is 36cm and that therefore the side length is 9cm.

$72 + 2 = 36$
 $\sqrt{36} = 6$

Because the sides have to be the same
So $\sqrt{36} =$ both the same number

6 cm

Incorrect; 0 marks

Common error Another common misconception is to confuse area and perimeter.

